E/CONF.39/A/16
26 Sept.1962
ORIGINAL : ENGLISH

UNITED NATIONS CONFERENCE
ON THE APPLICATION OF SCIENCE AND TECHNOLOGY
FOR THE BENEFIT OF THE LESS DEVELOPED AREAS

Agenda Item: A.4.1

United Kingdom

SURVEY, DEVELOPMENT AND UTILIZATION OF ENERGY RESOURCES

By Albert PARKER, C.B.E., D.Sc.,
Consultant

Papers have been contributed to the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas as working papers for that Conference. They are published as presented by the contributors, and the contents and the views expressed are those of the contributors. (See notes overleaf.)

United Nations use an equivalent of 1.3 for crude petroleum and 1.5 for gasoline, kerosine, and fuel oils. For hydro-electricity, Table 1 takes 2,300 kWh as equivalent to one tonne of coal on the basis of an average thermal efficiency of about 28 per cent for electricity power stations fired with coal or oil or natural gas, whereas the publications of the United Nations take one tonne of coal as equivalent to 8,000 kWh, that is on a basis of about 100 per cent for the efficiency of thermal power stations.

Table 1 - Population, and Income, Net Food Supply, and Energy Consumption per Capita for Selected Countries in 1960

1 Country	2 Population millions	3 Income equivalent U.S. dollars per annum	4 Net Food calories per day	5 Energy coal equiv. tonnes p. annum
U.S.A.	180.7	2289	3100	8.79
Canada	17.8	1545	3100	7.90
U. Kingdom	52.5	1084	3200	5.12
Belgium	9.2	978	2900	4.27
W. Germany	53.4	967	2900	4.02
Netherlands	11.5	803	3000	3.04
Italy	49.4	509	2700	1.57
Japan	93.2	341	2200	1.42
India	432.6	62	1800	0.15
Nigeria	35.1	84	--	0.05
World	2995	--	--	1.53

3. One point of importance in considering available data for energy consumption is that many countries, particularly the less developed areas, use large quantities of wood, sometimes to the detriment of afforestation, and of various vegetable and animal wastes as non-commercial fuels, the quantities of which are not recorded. In many parts of India, for example, animal dung is a common fuel and in Nigeria large quantities of wood are used. If allowances are made for the consumption of the non-commercial fuels, it is probable that the coal equivalent of the annual consumption of fuel and power per inhabitant in Nigeria is at least equal to that in India.

4. The important conclusion is that ample supplies of energy at reasonable prices are required if a country is to be prosperous and is to maintain the population at a good standard of living. It is necessary, therefore, in planning the development of the less developed areas to have trustworthy information on the various, indigenous energy resources and the probable costs of their exploitation. If indigenous supplies are insufficient to meet requirements, or their exploitation would be uneconomic, the probable costs of imported sources of energy should also be ascertained.

5. Shortly after its formation in 1924, the World Power Conference recognized the need for a survey of the energy resources in the various areas and countries of the world. In 1929 the first major step was taken by the publication of a book on the "Power Resources of the World, Potential and Developed". Later, during the period 1936 to 1960, the Conference published nine Statistical Year-Books giving the available data on energy resources and annual statistics for the years 1933 to 1958 on the production and utilization of the various forms of energy in each of many countries. In 1952, the United Nations began their J Series of Statistical Papers giving data on the annual production, trade, and consumption of the commercial solid, liquid, and gaseous forms of energy and of electricity in the different countries and areas of the world. Five of this J Series of Statistical Papers have been published, covering the years 1929 to 1960.

6. It is not the intention of the United Nations to collect and publish data on energy resources. The World Power Conference has begun, therefore, a new series of publications on Surveys of Energy Resources. The first of this new series was published on the occasion of the Sixth Plenary Meeting of the Conference in Melbourne, Australia in October, 1962. It is intended to publish new issues at intervals of six years, that is in each year in which a Plenary Meeting of the Conference is to be held.

7. A study of the available data shows that for the world as a whole there are ample resources of the commercial forms of energy - coals and lignites, oil, natural gas, water power, and uranium and thorium as nuclear fuels - to meet requirements over a long period of time. The total of the measured, indicated and inferred reserves of coals and lignites, even assuming that only one-third could economically be recovered, is about 1200 times the present annual consumption and the similar reserves of petroleum are equal to at least 60 times present annual consumption. In addition, there are large reserves of oil in oil shales and bituminous sands that have hardly been touched because the extraction of the oil has not been economic while ample supplies of petroleum have been available. The measured and indicated reserves of natural gas are equal to more than 150 times present annual consumption. It should be practicable to double the present world rate of production of hydro-electricity and the possibilities of obtaining useful energy by developments in nuclear fission and nuclear fusion are almost unlimited. There are also the possibilities of the further development of economic methods of utilising in certain parts of the world the heat energy within the earth and the income of energy available in such forms as solar radiation, tidal power, and wind power.

8. It must be recognized, however, that the rate of production and utilization of the fossil fuels is increasing.

During the past ten years it has increased by more than 60 per cent and over the last thirty years it has more than doubled. The increase will continue though probably not at the same high rate as during the past ten years. As surveys are extended, however, it is certain that other substantial resources of energy will be discovered, particularly in the less developed areas, which, in general, have not been systematically surveyed.

9. The main problem is that of economics. Costs must differ considerably in different areas owing to the uneven distribution and accessibility of the energy resources and the heavy costs often involved in the transport of materials and energy in their various forms. Of the recorded resources of coals and lignites, nearly seven-eighths is in the U.S.S.R., the U.S.A., and China; two-thirds of the proved oil reserves is in the Middle East; while seven-eighths of the reserves of natural gas is in the U.S.A., the U.S.S.R., the Sahara, and Canada. Of the hydro-electricity now being generated, one-quarter is in the U.S.A., one-seventh in Canada, and one-twelfth in the U.S.S.R.

10. In planning the development of the less developed areas there should first be systematic topographical, geological, and economic surveys. The topographical maps should show the areas of population, and existing railways, roads, waterways as means of transport. Measurements should be made of river flows and their variations at selected points of known elevation. From the information so obtained, estimates can be made of the amounts of electricity that could economically be generated by planned hydro-electric schemes, often in combination with schemes of irrigation to improve agricultural productivity.

11. Exploration by well-planned drillings at selected points to ascertain the resources of coals and lignites, oil, and natural gas is of great importance. Representative samples should be examined to obtain information on the physical and chemical properties of these sources of energy and chemicals that may be discovered. Estimates should be made of the probable costs of mining or extracting the solid, liquid, and gaseous fuels, of treating them to render them suitable for the probable uses, and of transporting them to the places at which they could be used with the greatest overall advantages.

12. It is also important to ascertain the available resources of iron ore and other minerals suitable for metallurgical industries, the improvements in agricultural productivity that could be achieved by mechanization and the use of fertilisers in farming, the increased production of constructional timber by planned afforestation, the possibilities of production of cement and other materials for the construction of roads, and the extent to which

mechanization in all fields could economically be developed in relation to costs of labour and the maintenance and extension of employment. In many instances it would not be economic nor desirable in the first stages to mechanize to the extent now practised in highly developed countries, where costs of labour are relatively high, as it might lead to serious unemployment and social upset for a time and overall costs higher than necessary. Progress in industrialisation and mechanization must be planned intelligently in stages to avoid over-burdening the financial position. National prestige cannot be achieved merely by having advanced agriculture and industry, irrespective of cost. It is dependent on financially successful agriculture and industry, with ample employment of local labour, and not on the unintelligent copying of schemes established in highly developed countries, where conditions may be very different.

13. As an example, the author can refer to a less developed area with which he is closely concerned. In the particular country there are useful resources of coal, iron ore, and limestone and other minerals; and recent surveys have indicated resources of oil and natural gas. Certain of the deposits of coal, iron ore and limestone are in close proximity to oneanother in a district where ample labour would be available, and where there are reasonable transport facilities. Other deposits of coal, iron ore and limestone, the resources of oil and natural gas, and potential water power are in districts not at present so readily accessible by rail or road. The problem is how best to develop the use of the energy and other resources in the broad national interest. This will only be achieved by intelligent planning based on systematic surveys, including surveys of the market possibilities for the various potential products.

14. The coal is non-coking in character and the deposits of iron ore so far found are not of particularly high quality. Fortunately, the coal can be mined at a relatively low price. Experimental and development work to the stage of trials in commercial coke ovens at a steel works in a highly industrialised country has shown that metallurgical coke can be produced at a reasonable price from a blend of the coal with coal-tar pitch, without briquetting. The proportions of lump coke and coke breeze that would be produced in coke ovens from the blend are such that the coke breeze could be used for sintering the iron ore so that there could be a suitable burden of coke, sintered iron ore, and limestone for a blast furnace. The amount of lump coke required could be reduced to some extent by the injection into the base of the blast furnace of a proportion of crushed coal or of oil. The probable markets for iron and steel are now being assessed with the object of deciding on the most suitable type and size of plant and situation for the economic development of an iron and steel industry in the particular circumstances. The possibilities of establishing other industries, such as those for the production of cement and glass, that require considerable

quantities of fuel and power are also being investigated.

15. In planning developments of this kind, advice and guidance from experts of wide knowledge and experience, who can assess the economic as well as the technical possibilities, are essential if the right decisions are to be made, the necessary financial support is to be attracted, suitable staff are to be obtained to initiate the different enterprises, and serious difficulties and even failures are to be avoided. Usually there should be a group of expert advisers working in close collaboration and independent of personal financial interest in any contracting work that may subsequently be required. When a plan has been devised and schemes have been selected for development, the independent experts should prepare the specifications and terms of contract for inviting tenders and advise on the relative merits of the tenders submitted; they should also supervise the work of any contractors engaged and approve the work before payments are made.

16. Another important step as soon as a development plan has been approved is to select a sufficient number of suitable young people from the particular country to be trained in the appropriate basic sciences and technology. In general their training will have to be obtained in countries with well-established universities and technical colleges. After graduation, most of these students should then have a period of practical training and experience in selected industrial establishments. In the early stages of development of a country relatively few of the graduates should be selected for research training in the universities. Over-emphasis of the attraction of obtaining a doctorate degree at a university is not always in the best interests of the country being developed.

17. In establishing new industries, well-trained and experienced staff will have to be obtained for a period of a few years to set up the necessary organization, to control the operation and maintenance of the plant and equipment, and to train native labour. During this period, those selected individuals who have received training in other countries in universities and technical colleges and in industry should be given junior supervisory appointments in the industries being established in their own country.

18. In this way native talent can, in course of time, take over management, technical supervision, and operation, with only occasional advice and guidance from experts from other countries. Early planning to ensure that there will be adequate training of native talent is stressed because the author knows of instances in which lack of foresight in this direction has led to serious and costly difficulties that could have been avoided.

198 E - Oct. 1962 - 1,500